REMARKS

Claim 4 is amended and is more particularly directed to an overmolded electrical component 10 that includes a circuit board substrate 12 having an electrical circuit, a semi-conductor chip 14 connected to the substrate and spaced apart by a distance of about 10 micrometers to 150 micrometers, solder interconnections 18 connecting the electrical circuit and the semiconductor chip, and a polymeric overmolding 25 encapsulating the semi-conductor chip on the substrate and filling the space between the semi-conductor chip and the substrate, as shown in Fig. 1 and described at paragraph 0014. The claim is also amended to recite that the polymeric composite that forms the overmolding includes inorganic filler particles that are characterized by dimensions between about 1 and 700 nanometers, as described at paragraph 0009.

Claim 13 is amended and is more particularly directed to an overmolded electrical component having a circuit board substrate, a semi-conductor chip, and a plurality of electrical connections similar to claim 4. Claim 13 is also amended to call for a polymeric overmolding encapsulating the semi-conductor chip on the substrate and filling the space between the semi-conductor chip and the substrate, also similar to claim 1.

Claim 24 is amended to clarify that the claim is directed to an overmolded electrical component and includes a polymeric overmolding overlying a surface of the semi-conductor chip opposite the space between the substrate and the semi-conductor space. The claim is further amended to call for inorganic filler particles in the polymeric composite that are characterized by a thickness between about 1 and 20 nanometers and a ratio of surface area of a face to the thickness of at least 100, as described in paragraph

0015.

Claim Objections

The objection to claim 24 is rendered moot by the amendments to the claim made herein.

Rejection of Claim 4 et al. based on Kaminaga et al. and Matayabas et al.

Claims 2 and 4-10 were rejected under 35 U.S.C. § 103 as unpatentable over United States Patent No. 6,257,215, issued to Kaminaga et al. in 2001, in view of United States Patent Application Publication No. 2004/0191503, by Matayabas et al.

In accordance with the aspect of Applicants' invention recited in claim 4, an overmolded electrical component is provided that includes a polymeric overmolding composed of a polymeric composite that contains inorganic filler particles that are platelets characterized by dimensions between about 1 and 700 nanometers, see paragraph 0009. Because of the nanoscale platelets, the filler content may be reduced while achieving a desired coefficient of thermal expansion. Also, the nanoscale particles reduce the viscosity during the overmolding process and thereby improve flow within the space between the chip and the substrate.

Referring to Fig. 1A, Kaminaga et al. shows an electrical assembly that includes electronic devices embedded in a transfer-molded epoxy package 7, col. 6, beginning at

line 3. The package is composed of 70% to 90% filler material, col. 6, lines 8-9. Moreover, Kaminaga et al. specifically discloses the use of rounded filler to reduce the risk of damage to the semiconductor components, col. 6, lines 11-13. Thus, Kaminaga et al. does not teach or suggest an overmolding formed of a polymeric composite having a low (less than 20%) filler content, or more particularly, a filler having a platelet structure and nanoscale dimensions, as in Applicants' invention.

The rejection points to Matayabas et al. Matayabas et al. discloses a thermal interface material that includes nanoscale platelet filler, paragraph 0024, which slows oxygen and water diffusion and so reduces pump-out, bleed-out and dry-out, paragraph 0037. Referring to Fig. 1, the thermal interface material is applied at joint 104 between semiconductor device 103 and heat spreader 105, paragraph 0028, or at joint 108 between heat spreader 105 and heat sink 106, paragraph 0030. The material is applied as a thin layer during assembly of the elements in order to promote heat transfer in the final product. Nothing in Matayabas et al. points to a formulation that is adapted for molding, e.g., forming an overmolding to encapsulate the semiconductor chip. Moreover, it is significant that the package 100 in Matayabas et al. includes a space between semiconductor device 103 and substrate 101, formed by connections 102. Matayabas et al. teaches that the gap may be filled by a conventional epoxy material, paragraph 0027. Nowhere does Matayabas et al. contemplate adding the nanoscale or platelet filler to the underfill used for sealing the gap. In accordance with Applicants' invention, the nanoscale platelets are used at low concentration to promote the flow of the polymeric

material within the gap, while achieving a suitable coefficient of thermal expansion. Matayabas et al. does not teach or suggest nanoscale platelet filler to promote flow within the gap, as in the overmolding of Applicants' invention.

Thus, the combination of references does not point the practitioner to Applicants' overmolded electrical component recited in claim 4. Kaminaga et al. employs a compound having rounded filler in high concentration. Matayabas et al. uses a conventional underfill between the chip and the substrate, and only employs nanoscale platelet filler in material that is applied as layers before joining elements, in marked contrast to flowing into a gap of 10 to 150 micrometers. When fairly read, the references do not lead to a polymeric composite containing 20 percent of less of a filler particles having a platelet structure with dimensions between about 1 and 700 nanometers, used in an overmolding that fills the space between the semi-conductor chip and the substrate, as called out in the claim.

Since the references do not show Applicants' overmolded electrical component in claim 4, it follows that they do not show the invention in claims 2 and 5-10, which are dependent upon claim 4 and so incorporate the features of claim 4.

Accordingly, it is respectfully requested that the rejection of the claims based upon Kaminaga et al. and Matayabas et al. be reconsidered and withdrawn, and that the claims be allowed.

Rejection of Claim 12 based on Kaminaga et al, Matayabas et al. and Capote et al.

Claim 12 was rejected under 35 U.S.C. § 103 as unpatentable over Kaminaga et al. and Matayabas et al. in vies of United States Patent No. 6,335,571, issued to Capote et al.

Claim 12 is dependent upon claim 4. For the reasons above, Kaminaga et al. and Matayabas et al. do not show Applicants' overmolded electrical component in claim 4. It follows then that they do not show the invention in dependent claim 12.

Capote et al. is applied to show polymeric composite having a CTE of 10 to 30 ppm/°C, within a range that overlaps the range of 5 to 20 ppm/°C recited in claim 12. However, Capote does not disclose a molding compound comprising a filler composed of nanoscale platelet particles, or more particularly, a filler having a platelet structure, characterized by dimensions between 1 and 700 nanometers and added in an amount of 20 percent or less, as called for in claim 4. Thus, even when combined with Capote et al., the references do not lead the practitioner to Applicants' overmolded electrical component in claim 4, or dependent claim 12.

Accordingly, it is respectfully requested that the rejection of claim 12 based upon Kaminaga et al., Matayabas et al. and Capote et al. be reconsidered and withdrawn, and that the claims be allowed.

Rejection of Claim 4 et al. based on Chuang et al. and Matayabas et al.

Claims 4 and 10-11 were rejected under 35 U.S.C. § 103 as unpatentable over United States Patent Application Publication No. 2004/0084758, issued to Chuang et al. in 2001, in view of Matayabas et al.

The rejection points to Fig. 1 and paragraph 0027 in Chuang et al. In paragraph 0027, Chuang et al. describes a second encapsulant 39 that is formed about a first encapsulant 38. It is significant that chip 36 is encapsulated within a first encapsulant 38 that is formed of a thermoset material, paragraph 0026. It is also significant that chip 36 is connected to lead 33 by a wire 37. Chuang et al. does not describe a chip mounted on a substrate with a space therebetween, or an overmolding process carried out to fill the space. Nor does it disclose an overmolding polymeric composite comprising nanoscale platelet filler.

Thus, even if combined with Matayabas et al., there is nothing in either reference to point the practitioner to an overmolded electrical component comprising a semi-conductor chip and a spaced apart from a substrate by a space of 10 to 150 micrometers. Nor is there anything in either reference to point the practitioner to an overmolding that fills the space and comprises 20 percent or less of an inorganic filler particles having a platelet structure and characterized by dimensions between about 1 and 700 nanometers. Without these features, the references cannot suggest Applicants' overmolded electrical component set forth in claim 4, or dependent claims 10 and 11.

Accordingly, it is respectfully requested that the rejection of claims 4 and 10-11 based upon Chuang et al. and Matayabas et al. be reconsidered and withdrawn, and that the claims be allowed.

Rejection of Claim 13 et al. based on Chuang et al. and Matayabas et al.

Claims 13 and 16-20 were rejected under 35 U.S.C. § 103 as unpatentable over Chuang et al. in view of Matayabas et al.

Claim 13 is amended to more particularly point out that the electrical component comprises a semi-conductor spaced apart from the substrate by a space of 10 to 150 micrometers, and a polymeric overmolding that fills the space and is formed of a thermoplastic resin. The package in Chuang et al. does not include a space between the chip and substrate that is filled by the encapsulant. Moreover, encapsulant in Chuang et al. that immediately surrounds the chip is formed of a thermoset resin, not a thermoplastic resin as called for in the claim. Matayabas et al. does not contemplate an overmolding, and to the extent that it may include an underfill, does not describe a composition therefore. Thus, there is nothing in the references to lead the practitioner to an overmolding that fills a space between the chip and substrate, which is formed of a thermoplastic resin, as called for in claim 13, or dependent claims 16-20.

Accordingly, it is respectfully requested that the rejection of claims 13 and 16-20 based upon Chuang et al. and Matayabas et al. be reconsidered and withdrawn, and that

the claims be allowed.

Rejection of Claim 13 et al. based on Kaminaga et al. and Matayabas et al.

Claims 13-14 and 16-19 were rejected under 35 U.S.C. § 103 as unpatentable over Kaminaga et al., in view of Matayabas et al.

Claim 13, as amended, calls for a semi-conductor chip spaced apart from the substrate by a space of 10 to 150 micrometers, and a polymeric overmolding that fills the space and is formed of a thermoplastic resin. The package 7 in Kaminaga et al. is formed of epoxy, which is a thermoset material, col. 6, lines 3-9. Matayabas et al. describes a material for joints in a heat transfer superassembly, does not show an overmolding, and so cannot be fairly read as pointing to a material suitable for such an overmolding, particularly an overmolding that underfills the chip. Thus, even if combined, the references do not lead the practitioner to the overmolded electrical component in claim 13 or dependent claims 16-20.

Accordingly, it is respectfully requested that the rejection of claims 13 and 16-20 based upon Kaminaga et al. and Matayabas et al. be reconsidered and withdrawn, and that the claims be allowed.

Claim Rejection based on Kaminaga et al. and Matayabas et al.

Claims 21-22 were rejected under 35 U.S.C. § 103 as unpatentable over Kaminaga et al. or Chuang et al. in view of Matayabas et al. and United States Patent No. 5,153,657, by Yu et al.

Claims 21 and 22 are dependent upon claim 13. For the reasons above, Kaminaga et al., Chuang et al., and Matayabas et al. do not teach or suggest Applicants' overmolded electrical component having the features of claim 13, including a space between the chip and the substrate that is filled by an overmolding composed of thermoplastic resin.

Yu et al. is applied to show a filler comprising glass spheres. However, Yu et al. relates to cleaning blade and does not point to an electrical component having an overmolding. In particular, Yu et al. does not teach or suggest a thermoplastic overmolding encapsulating a semiconductor chip and filling the space between the chip and the substrate. Thus, even if combined with Kaminaga et al., Chuang et al., and Matayabas et al., the references do not lead the practitioner on an obvious path to Applicants' overmolded electrical component in claim 13, or dependent claims 21 and 22.

Accordingly, it is respectfully requested that the rejection of claims 13 and 21-22 based upon Kaminaga et al., Chuang et al., Matayabas et al. and Yu et al. be reconsidered and withdrawn, and that the claims be allowed.

Rejection of Claim 24 based on Charles et al., Kaminaga et al. and Matayabas et al.

Claim 24 was rejected under 35 U.S.C. § 103 as unpatentable over United States Patent Application Publication No. 5,153,657, by Charles et al., in view of Kaminaga et al. and Matayabas et al.

Claim 24 is directed to Applicants' overmolded electrical component that includes a polymeric overmolding that fills the space between the semi-conductor chip and the substrate. In accordance with the claim, the overmolding includes an inorganic filler (a) having a platelet structure, (b) characterized by a thickness between about 1 and 20 nanometers, and (c) characterized by a high surface area to thickness ratio of at least 100.

Charles et al. describes an electronic article comprising an electronic component bonded to a substrate by an underfill adhesive that includes spherical nanoparticles, see Abstract and paragraph 0040. Thus, Charles et al. is consistent with the teaching in Kaminaga et al. to use rounded filler in underfill material to reduce the risk of damage to the components, see Kaminaga et al., col. 6, lines 10-13. Thus, nothing in Charles et al. nor Kaminaga et al. points the practitioner to an overmolding formed of a polymer composite including inorganic filler having a platelet structure, a thickness between 1 and 20 nanometers, and a high surface-to-thickness ratio. Matayabas et al. describes a material having nanoscale platelet filler. However, the material in Matayabas et al. is applied as a layer in bonding elements together, and is not adapted for molding to

underfill the chip. Thus, nothing in any of the references points the practitioner to substitute the filler in Matayabas et al. for the spherical filler in Charles et al. or Kaminaga et al. Accordingly, the references do not teach or suggest Applicants' overmolded electrical component in claim 24.

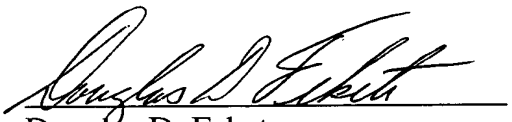
Therefore, it is respectfully requested that the rejection of claim 24 based upon Charles et al., Kaminaga et al., and Matayabas et al. be reconsidered and withdrawn, and that the claim be allowed.

Conclusion

It is believed, in view of the amendments and remarks herein, that all grounds of rejection of the claims have been addressed and overcome, and that all claims are in condition for allowance. If it would further prosecution of the application, the Examiner is urged to contact the undersigned at the phone number provided.

The Commissioner is hereby authorized to charge any fees associated with this communication to Deposit Account No. 50-0831.

Respectfully submitted,



Douglas D. Fekete
Reg. No. 29,065
Delphi Technologies, Inc.
Legal Staff – M/C 480-410-202
P.O. Box 5052
Troy, Michigan 48007-5052

(248) 813-1210